

06/21/00

Attorney's Docket No. 025219-260

jc833 U.S. PTO  
09/598372  
  
06/21/00

**UTILITY PATENT  
APPLICATION TRANSMITTAL LETTER**

**Box PATENT APPLICATION**  
Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Enclosed for filing is the utility patent application of Laurent Ouvry, Didier Varreau, Didier Lattard and Sebastien Leveque for CDMA RECEIVER WITH PARALLEL INTERFERENCE SUPPRESSION AND OPTIMIZED SYNCHRONIZATION.

Also enclosed are:

- ☒   4   sheet(s) of ☒ formal   ☐ informal drawing(s);
- ☒ a claim for foreign priority under 35 U.S.C. §§ 119 and/or 365 is ☐ hereby made to                   
filed in        on    ;  
☒ in the declaration;
- ☒ a certified copy of the priority document;
- ☐ a General Authorization for Petitions for Extensions of Time and Payment of Fees;
- ☐              statement(s) claiming small entity status;
- ☐ an Assignment document;
- ☐ an Information Disclosure Statement; and
- ☐ Other: \_\_\_\_\_
- ☒ An ☐ executed ☒ unexecuted declaration of the inventor(s)  
☒ also is enclosed ☐ will follow.
- ☐ Please amend the specification by inserting before the first line the sentence --This application claims priority under 35 U.S.C. §§119 and/or 365 to        filed in        on    ; the entire content of which is hereby incorporated by reference.--
- ☐ A bibliographic data entry sheet is enclosed.



**21839**

(05/00)

☒ The filing fee has been calculated as follows ☐ and in accordance with the enclosed preliminary amendment:

C L A I M S					
	NO. OF CLAIMS		EXTRA CLAIMS	RATE	FEE
Basic Application Fee					\$690.00 (101)
Total Claims	3	MINUS 20 =	0	x \$18.00 (103)	0.00
Independent Claims	1	MINUS 3 =	0	x \$78.00 (102)	0.00
If multiple dependent claims are presented, add \$260.00 (104)					0.00
Total Application Fee					690.00
If verified Statement claiming small entity status is enclosed, subtract 50% of Total Application Fee					0.00
Add Assignment Recording Fee \$40.00 (581) if Assignment document is enclosed					0.00
<b>TOTAL APPLICATION FEE DUE</b>					<b>690.00</b>

☒ This application is being filed without a filing fee. Issuance of a Notice to File Missing Parts of Application is respectfully requested.

☐ A check in the amount of \$ \_\_\_\_\_ is enclosed for the fee due.

☐ Charge \$ \_\_\_\_\_ to Deposit Account No. 02-4800 for the fee due.

☐ The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17 and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800. This paper is submitted in duplicate.


Please address all correspondence concerning the present application to:

Robert E. Krebs, Esq.  
Burns, Doane, Swecker & Mathis, L.L.P.  
P.O. Box 1404  
Alexandria, Virginia 22313-1404.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

Date: June 20, 2000

By:   
Robert E. Krebs  
Registration No. 25,885

P.O. Box 1404  
Alexandria, Virginia 22313-1404  
(650) 622-2300

CDMA RECEIVER WITH PARALLEL INTERFERENCE  
SUPPRESSION AND OPTIMIZED SYNCHRONIZATION

DESCRIPTION

5

TECHNICAL FIELD

The present invention relates to a CDMA (code division multiple access) receiver with parallel interference suppression and optimized synchron-  
10 ization.

More generally, the invention relates to direct sequence spread spectrum (DSSS) digital transmission.

15 The invention has applications in radiocommunications systems with mobiles, in wireless local area networks (WLAN), in wireless local loops (WLL), in cable television and online multimedia services, in integrated home systems and electronic funds transfer, etc.

20 PRIOR ART

Direct sequence spread spectrum consists of modulating each symbol of a digital signal by a binary pseudorandom sequence. Such a sequence consists of N pulses or chips, whose duration  $T_c$  is equal to  $T_s/N$ . The  
25 modulated signal has a spectrum spread over a range N times wider than that of the original signal. On reception, demodulation consists of correlating the signal with the sequence used on transmission making it possible to once again find the information linked with the starting symbol.

30

This procedure has numerous advantages:

- discretion, because the spectral power density of the signal is reduced by a factor N;
- immunity against deliberate or parasitic, narrow band transmissions,  
35 because the correlation operation carried out at the receiver leads to the spectral spread of such transmissions;

- difficult interception, because demodulation requires the knowledge of the sequence used on transmission;
- resistance to multiple paths which, under certain conditions, give rise to selective frequency fading and consequently partly affect the transmitted signal;
- possible multiple access by the allocation of different sequences to different users.

The direct sequence spread spectrum modulation method has been extensively described in the specialist literature and reference can e.g. be made to the following:

- "CDMA Principles of Spread Spectrum Communication", by Andrew J. VITERBI, Addison-Wesley Wireless Communication Series;
- "Spread Spectrum Communications", by Marvin K. SIMON et al., vol. I, 1983, Computer Science Press;
- "Spread Spectrum Systems", by R.C. DIXON, John WILEY and Sons.

The attached fig. 1 illustrates the principle of a spread spectrum signal receiver. The receiver shown receives a signal  $r(t)$  and comprises a first circuit 10, referred to hereinafter as the correlation means, and which can be a matched filter or a sliding correlator, a circuit 12 for recovering a symbol clock signal, which makes it possible to synchronize the receiver means, optionally a processing circuit 14 able to perform various supplementary processing operations, such as a delayed multiplication, a channel estimation, etc. and finally a circuit 16 able to take a decision on the value of the transmitted symbol.

The first circuit of said receiver (correlation means 10), no matter whether it is a sliding correlator or a matched filter, plays an important part which can be defined with the aid of figs. 2 and 3.

A sliding correlator (fig. 2) diagrammatically comprises a pseudo-

random sequence generator 20 and a multiplier 22 receiving the input signal  $r(t)$  and the sequence delivered by the generator 20, an adder 24, a circuit 26 connected to the output of the adder 24 and relooped thereon and effecting a time lag. The sliding correlator output is  
5 connected to an undersampler 28. The circuits 20, 26, 28 are controlled by a symbol clock signal  $H_s$ .

The matched filter (fig. 3) is generally a digital filter 30, whose coefficients are matched to the sequence used. This filter receives  
10 the input signal  $r(t)$  and delivers a filtered signal applied to an undersampler 28, which is controlled by the symbol clock signal  $H_s$ .

Viewed from the output of the undersampler 28, said two architectures are equivalent. However, viewed from the input of the undersampler 28,  
15 they are different, because they do not deliver the same signal, as is revealed by figs. 4, 5 and 6.

Fig. 4 shows the output  $S_f$  of the matched digital filter of fig. 3, as a function of the rank  $n$  of the samples. Fig. 5 shows the output  $S_c$  of  
20 the sliding correlator when the local replica of the transmitted sequence is aligned with the transmitted sequence. Fig. 6 shows the output  $S_c$  of said sliding correlator when the local replica of the sequence is not aligned with the transmitted sequence. The correlation peak carrying the information on the symbol is marked P in figs. 4 and  
25 5.

These drawings show that the sliding correlator needs an information linked with the timing of the symbols, so-called symbol clock signal and designated  $H_s$  to enable the local replica of the sequence to be  
30 aligned with the sequence modulating the symbols received, otherwise the demodulation of the symbols is impossible (case of fig. 6). The matched filter does not require this information. Thus, what firstly differentiates a sliding correlator structure and a matched filter structure is that the former needs an external synchronization

35

information.

A matched filter makes it possible to recover the symbol clock, e.g. by a recursive detection of the correlation peak on a window of N points (fig. 4). It is also possible to recover the symbol clock with the aid of a sliding correlator, but this is more complex. There is a need for a stepwise modification of the phase of the local replica of the sequence until the output of the sliding correlator corresponds to an energy maximum and consequently to a correlation peak (case of fig. 5).

10

Although both these structures make it possible to find the symbol clock again, they do not do so at the same speed. The symbol clock recovery operation lasts a maximum of N symbol periods, i.e. NTs with a sliding correlator, whereas it only requires a single symbol period  $T_s$  with a matched filter.

Thus, the advantage of the matched filter is obvious with respect to the symbol clock signal acquisition speed. Its disadvantage is its operational complexity, because its installation in the form of a finite pulse response digital filter (operating at the speed of the chips multiplied by the number of samples) requires N multiplications and N additions for each sample. Thus, its structural complexity is linked with its operating complexity.

25 The sliding correlator only performs one multiplication and one addition for each new sample. Thus, although it is relatively poorly adapted to the clock recovery, it is very advantageous from the operating complexity standpoint.

30 The CDMA method can be of two types. If the different transmitters of users do not have a common time reference the system is said to be asynchronous, because the starts of the symbols of each user arrive at the receiver at different times. It is also possible to proceed in such a way that the starts of the symbols received from the different

35

users (modulo period  $T_s$  of a symbol). The system is then said to be synchronous. Asynchronous systems have the major advantage of not requiring an external synchronization signal, unlike in synchronous systems, but this is to the detriment of more serious constraints with respect to the spread sequence properties.

Thus, in an asynchronous CDMA system, the sequences have random relative phases at the reception level. Thus, a good separation of the signals assumes that the intercorrelations between sequences are small, no matter what the relative phases between the sequences.

If  $g_i(t)$  and  $g_k(t)$  are used for designating two pseudorandom sequences allocated to users  $i$  and  $k$ , it is possible to define a coefficient  $\mu_{i,k}$  translating the correlation between these two sequences. This coefficient is equal to the mean, on the duration  $T_s$  of a symbol, of the product of the sequences, i.e.:

$$\mu_{i,k} = \frac{1}{T_s} \int_0^{T_s} g_i(t)g_k(t)dt.$$

This coefficient represents an autocorrelation if  $i=k$  and an intercorrelation if  $i \neq k$ .

The signal at the output of the correlator corresponding to the user of rank  $k$  (i.e. following the undersampler 28 of fig. 2) can be written, as a function of its coefficient:

$$A_k d_k + \sum_{\substack{i=0 \\ i \neq k}}^{K-1} \mu_{i,k} A_i d_i + \frac{1}{T_s} \int_0^{T_s} n(t) \cdot g_k(t) \cdot dt$$

where  $A_k$  is the amplitude of the signal of the user of rank  $k$ ,  $g_k(t)$  the pseudorandom sequence of said same user,  $d_i$  the transmitted data and  $n(t)$  an additive, Gaussian, white noise. In this expression,  $i$  ranges from 0 to  $K-1$ ,  $K$  being the total number of users, but without assuming the value  $k$  of the user in question.



The first term, i.e.  $A_k d_k$  makes it possible to again find the data item  $d_k$ , the second term corresponding to a correlation with the signals corresponding to other users. This term is called multiple access interference or MAI.

5

The existence of this multiple access interference leads to a non-negligible consequence with respect to the capacity of the transmission system, i.e. the number of acceptable simultaneous users and on the performance characteristics of the system.

10

Much research has been carried out with the aim of reducing this interference phenomenon and reference can be made to the following:

- research on pseudorandom spread sequences,
- research on the management of the power levels of different transmitters,
- 15     the use of adaptive antennas,
- research on higher performance receiver structures.

15

The latter research has more particularly involved "suboptimum" receiver structures which, unlike an optimum structure, effect a good compromise between performance characteristics and operating complexity. Among these, interest is attached to parallel interference suppression structures and details of these are given below.

20

25 A parallel interference suppression receiver generally uses:

- a first stage based on a conventional detector with a bank of correlation means,
- means for generating an interference signal,
- means for suppressing in said signal interference produced by other system users,
- 30     a final stage of estimating the final data.

30

Such a procedure is described in the article by R.M. BUEHRER et al. entitled "Analysis of DS-CDMA Parallel Interference Cancellation with

35

Phase and Timing Errors", published in IEEE Journal of Selected Areas in Communications, vol. 14, No. 8, October 1996, pp 1522-1535. The corresponding receiver is illustrated in the attached fig. 7 in the case of three users. The reception signal  $r(t)$  is processed in a first

5 interference suppression stage  $ESI_1$  constituted by three user correlation means 101, 102, 103. These correlation means deliver three decision signals  $Z_1^1, Z_2^1, Z_3^1$ , which are processed in three interference estimation circuits 111, 112, 113. The latter deliver signals  $\hat{S}_1^1, \hat{S}_2^1, \hat{S}_3^1$ , which are obtained by the spreading of signals  $Z$  by the pseudo-

10 random sequences of three users. For each user, the signals  $\hat{S}$  of the other users are summated, i.e. respectively  $\sum_{2,3}$  for user 1,  $\sum_{1,3}$  for user 2 and  $\sum_{1,2}$  for user 3. These sums are subtracted from the reception signal  $r(t)$  in three subtractors 121, 122, 123 in order to obtain three new signals  $r_1^1, r_2^1, r_3^1$ .

15 In turn, the signals  $r_1^1, r_2^1, r_3^1$  can be processed in a second interference suppression stage and so on up to the  $i$ th interference suppression stage  $ESI_i$ . Thus, freed from at least part of the multiple access noise, the signals  $r_1^1, r_2^1, r_3^1$  permit a better estimate of the interference to be subtracted from the signal received  $r(t)$ . In the

20 stage of rank  $i$ , i.e.  $ESI_i$ , are only shown the subtractors with the signals  $r_1^i, r_2^i$  and  $r_3^i$ .

The receiver comprises a final stage or decision stage ED, with three

25 channels containing correlation means 141, 142, 143 and three decision circuits 151, 152, 153 delivering the data  $d_1, d_2, d_3$ .

In each stage there are synchronization means for the control of the different circuits. Thus, the first stage  $ESI_1$  contains synchronizing

30 circuits 131, 132, 133 controlling the correlation means 101, 102, 103 and estimation means 111, 112, 113. In the final stage ED there are synchronizing means 161, 162, 163 controlling the correlation means 141, 142, 143 and decision means 151, 152, 153.

in general terms, for constructing a multiple access interference correction signal, there is a need for three informations:

- 1) a symbol clock ( $H_s$ ),
- 2) the amplitudes and
- 5 3) the signs of signals carried on the channels I and Q after correlation, i.e.  $A(I)$  and  $A(Q)$ .

All these informations are calculated or recorded for each stage, for the control of said stage and independently of what takes place in the  
10 other stages.

Although this arrangement makes it possible to obtain a correct operation of the receiver it is still relatively complex. The invention obviates this disadvantage by proposing a simpler structure, which also  
15 makes it possible to turn to the best account the performance characteristics of the correlation means.

#### DESCRIPTION OF THE INVENTION

20 Use is made of a system with direct sequence spread spectrum and several optionally asynchronous transmitters. At the parallel interference suppression receiver, the correlation peak or peaks corresponding to the different propagation paths of the signal of user  $k$  are placed precisely at the same locations in the symbol window, no matter what  
25 the considered suppression stage for a given symbol. Thus, the signal received contains the replicas of the signal transmitted by the user  $k$  associated with the propagation paths, at a fixed location for a given symbol in the symbol window. The time positions are estimated in the synchronization means and can doubtless be considered as different  
30 between individual stages, because during the suppression stages interference is progressively removed from the signal. However, the information received does not move relative to the window of the considered symbol. Thus, a single synchronization signal per path is sufficient and not one per path and per stage.

35

Thus, the applicant has decided to use the synchronization signal or signals calculated in the final receiver stage, said signals being less error-tainted, for controlling all the interference suppression stages for each user.

5

Thus, the invention renders unnecessary complex calculations for investigating clock signals at all the first stages and consequently considerably reduces the operational complexity of the receiver. This complexity can be further reduced by the use of sliding correlators in  
10 the first stages and matched filters in the final stage. As explained hereinbefore, the matched filter makes it possible to acquire the synchronization in a single symbol period, whilst the use of sliding correlators makes it possible to reduce the operational complexity without deteriorating said acquisition time.

15

More specifically, the present invention relates to a receiver for multiplex access transmission with distribution by codes and parallel multiple access interference suppression comprising:

- at least one multiple access interference suppression stage constituted by K channels, each comprising a correlation means corresponding to a particular pseudorandom sequence and interference generation and suppression means, each stage delivering to the following stage K signals at least partly freed from multiple access interferences,
- 20 - a final, decision stage constituted by K channels receiving the K signals from the K channels of the preceding suppression stage and each comprising a correlation means corresponding to one of the pseudorandom sequences and decision means delivering a data item,
- means for producing the synchronization signals able to control the  
30 interference suppression means,
- means for producing synchronization signals able to control the decision means of the final stage,

said receiver being characterized in that the means for producing the synchronization signals are constituted by K means placed solely in the

35

K channels of the final stage, the K synchronization signals produced by these K means controlling the K decision means of the K channels of the final stage and the interference estimation means of the K channels of the interference suppression stages, following appropriate time shifts.

Thus, preferably, the K synchronization signals also control the K correlation means.

Preferably, the K correlation means of the K channels of the final stage are constituted by K matched filters with K pseudorandom sequences and the K correlation means of the K channels of each interference suppression stage are constituted by K sliding correlators.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1, already described, shows a known spread spectrum receiver.

Fig. 2, already described, shows a sliding correlator.

Fig. 3, already described, shows a matched filter.

Fig. 4, already described, shows the output signal of a matched filter.

Fig. 5, already described, shows the output signal of a sliding correlator when the local replica of the sequence is aligned with the transmitted sequence.

Fig. 6, already described, shows said same output signal when the local replica is not aligned with the transmitted sequence.

Fig. 7, already described, shows a CDMA receiver with multiple access interference suppression according to the prior art.

Fig. 8 shows a receiver according to the invention.

#### DESCRIPTION OF EMBODIMENTS

5 Fig. 8 illustrates an embodiment of a receiver according to the invention. Fig. 8 corresponds to fig. 7 and the same means carry the same references. It is obvious that the invention is not limited to three channels and in fact extends to K channels, K being random. Moreover, the number i of multiple access interference suppression stages is also  
10 of a random nature.

In fig. 8, the synchronization means are constituted by the three means 171, 172, 173 in the decision stage ED, said means being used not only in the channels of the final stage, but also in the interference suppression stages like stage  $ESI_1$ , where the signals delivered by the  
15 means 171, 172, 173 are applied to the correlation means 101, 102, 103 and to the estimation circuits 111, 112, 113, following an appropriate time shift supplied by the circuits 181, 182, 183 comprising, modulo the symbol period, the processing time.

20 The correlations means 141, 142, 143 of the final stage are advantageously matched filters making it possible to acquire the synchronization in a single symbol period, whereas the correlation means 101, 102, 103 of the interference suppression stages are sliding correlators, which  
25 reduces the complexity without any deterioration to the acquisition time.

30

35

CLAIMS

1. Receiver for code distribution multiple access transmission and parallel multiple access interference suppression, comprising:
  - 5 - at least one multiple access interference suppression stage ( $ESI_i$ ) constituted by K channels, each comprising a correlation means (101, 102, 103) corresponding to a particular pseudorandom sequence and interference generation (111, 112, 113) and suppression (121, 122, 123) means, each stage delivering to the following stage K signals  
10 ( $r_1^i, r_2^i, r_3^i$ ) at least partly freed from multiple access interferences,
  - a final, decision stage (ED) constituted by K channels receiving the K signals from the K channels of the preceding suppression stage and each comprising a correlation means (141, 142, 143) corresponding  
15 to one of the pseudorandom sequences and decision means (151, 152, 153) delivering a data item ( $d_1, d_2, d_3$ ),
  - means (131, 132, 133) for producing synchronization signals able to control the interference suppression means,
  - means (161, 162, 163) for producing synchronization signals able to  
20 control the decision means (151, 152, 153) of the final stage (ED), said receiver being characterized in that the means for producing the synchronization signals are constituted by K means (171, 172, 173) solely placed in the K channels of the final stage (ED), the K synchronization signals produced by said K means controlling the K decision  
25 means (151, 152, 153) of the K channels of the final stage (ED) and the interference estimation means (111, 112, 113) of the K channels of the interference suppression stages ( $ESI_i$ ) following appropriate time shifts (181, 182, 183).
- 30 2. Receiver according to claim 1, wherein the K synchronization signals also control the K correlation means (101, 102, 103).
3. Receiver according to claim 1, wherein the K correlation means (141, 142, 143) of the K channels of the final stage (ED) are

35

constituted by K matched filters with K pseudorandom sequences and the K correlation means (101, 102, 103) of the K channels of each interference suppression stage ( $ESI_1$ ) are constituted by K sliding correlators.

5



## DESCRIPTIVE ABSTRACT

CDMA receiver with parallel interference suppression and optimized synchronization.

According to the invention, the synchronization means are placed in the final stage (ED) and are used both in the final stage (ED) and in the preceding interference suppression stages ( $ESI_1$ ,  $ESI_1$ ).

Application to radiocommunications with mobiles.

(Fig. 8)

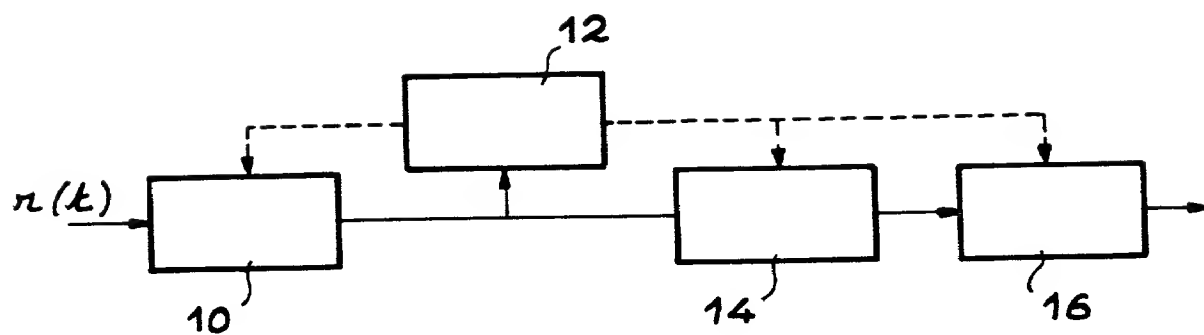


FIG. 1

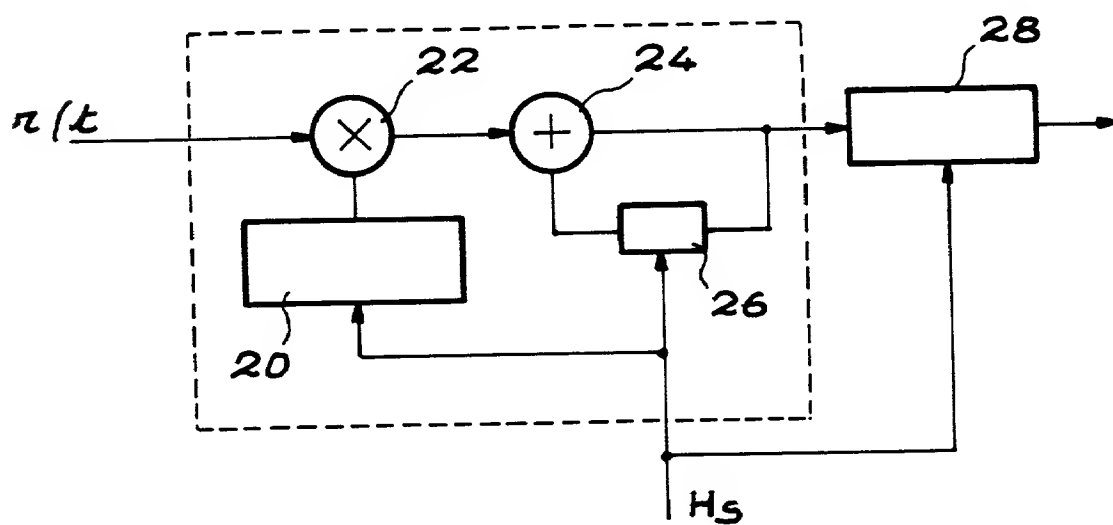


FIG. 2



FIG. 3

FIG. 4

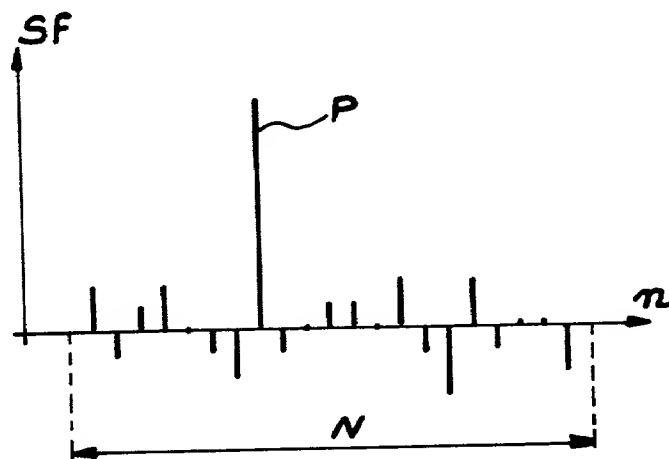


FIG. 5

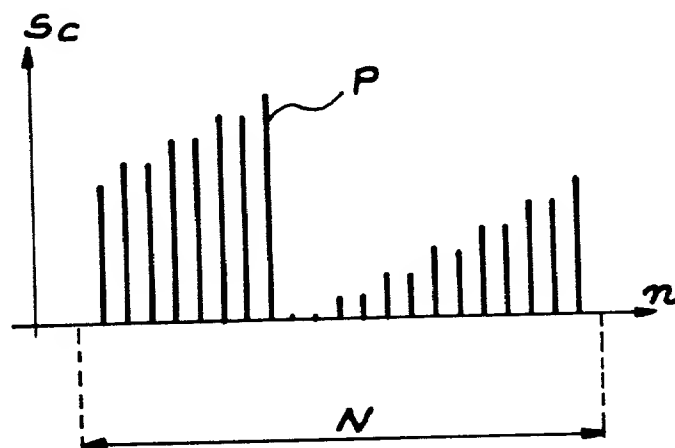
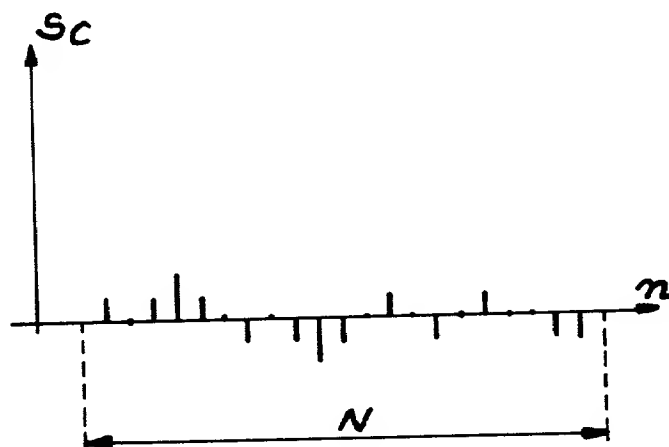


FIG. 6



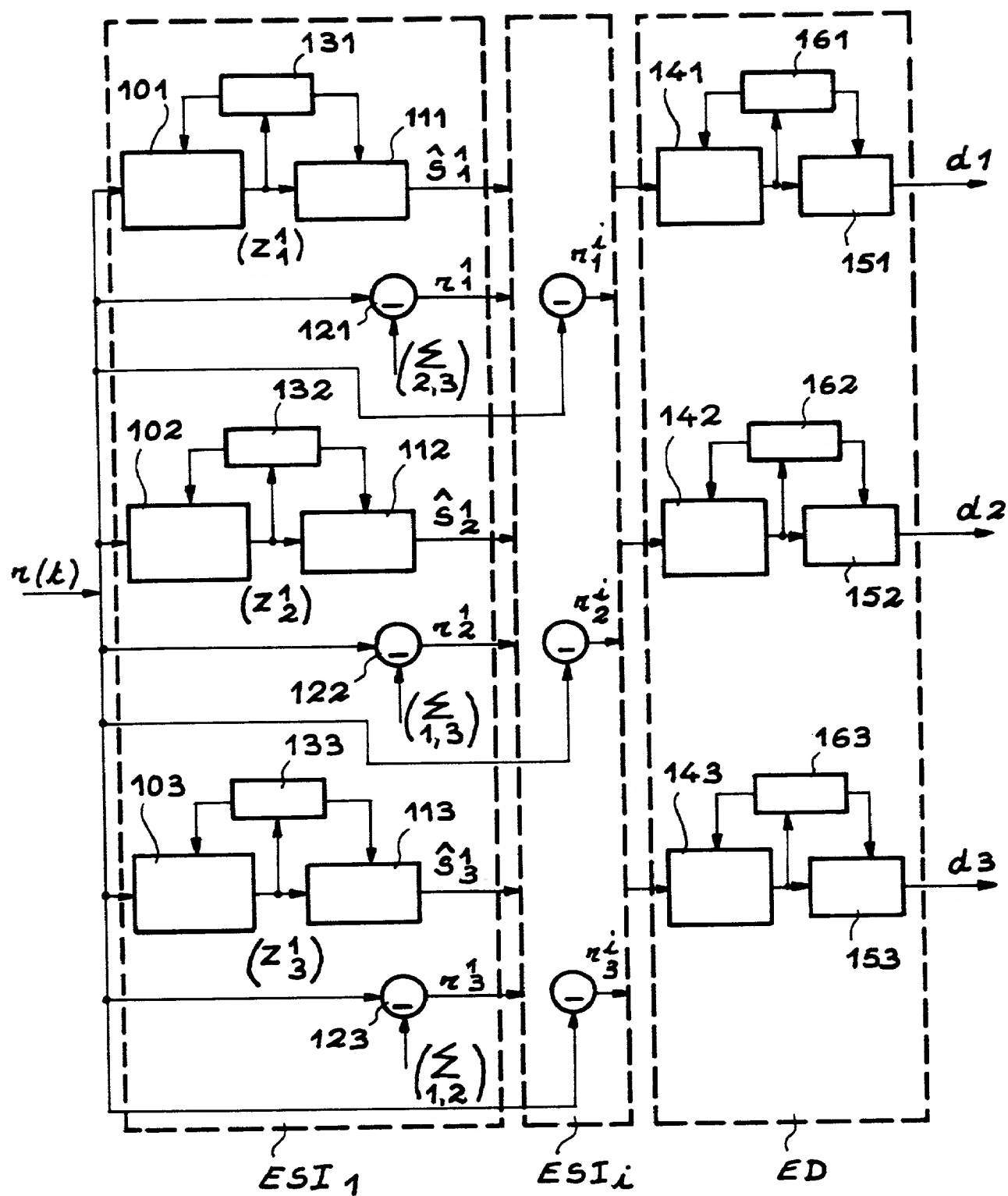


FIG. 7

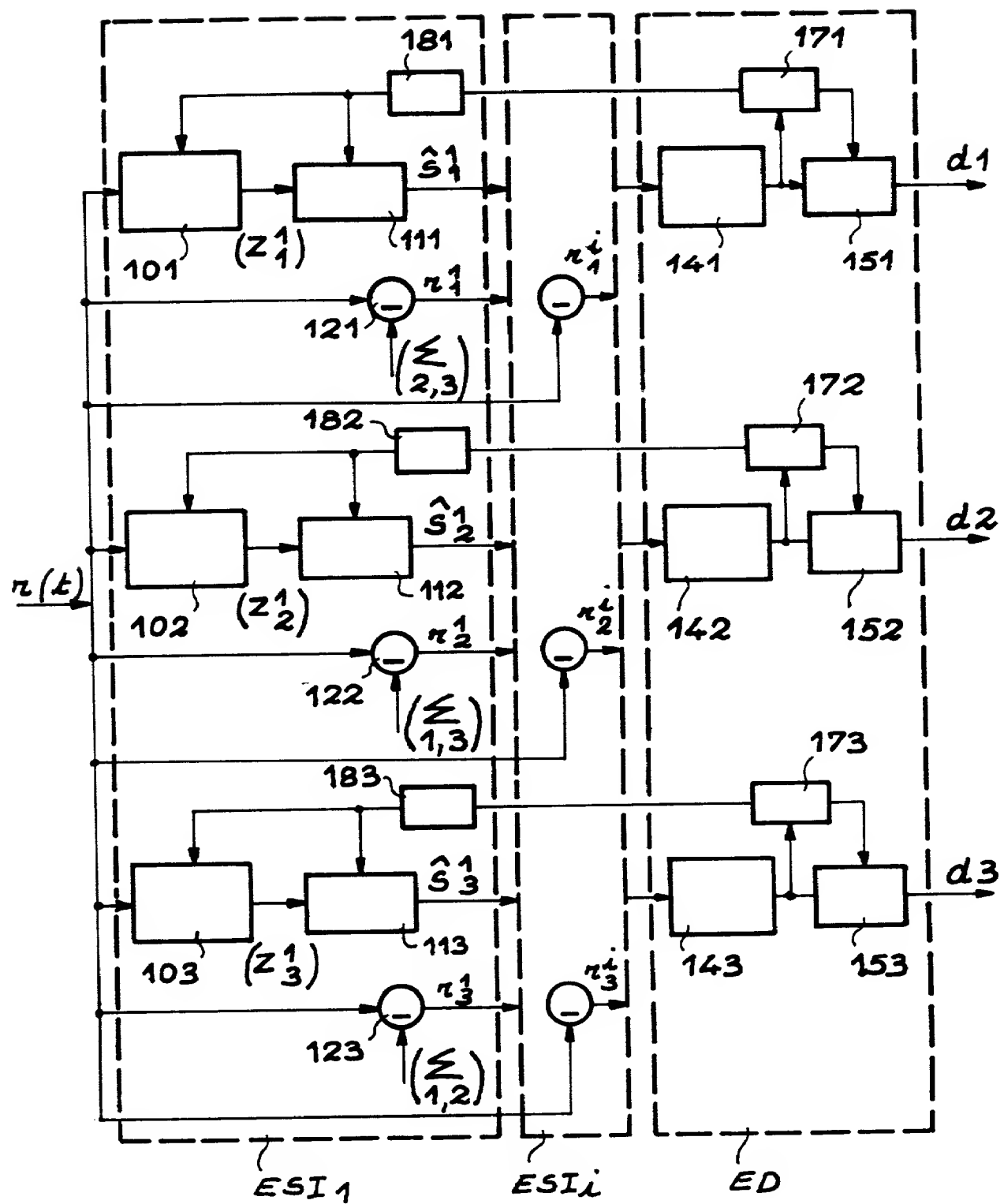


FIG. 8

**COMBINED DECLARATION AND POWER OF ATTORNEY  
FOR UTILITY PATENT APPLICATION**

Attorney's Docket No.

025219-260

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I BELIEVE I AM THE ORIGINAL, FIRST AND SOLE INVENTOR (if only one name is listed below) OR AN ORIGINAL, FIRST AND JOINT INVENTOR (if more than one name is listed below) OF THE SUBJECT MATTER WHICH IS CLAIMED AND FOR WHICH A PATENT IS SOUGHT ON THE INVENTION ENTITLED:

CDMA RECEIVER WITH PARALLEL INTERFERENCE SUPPRESSION AND OPTIMIZED SYNCHRONIZATION

the specification of which

(check one)



is attached hereto;



was filed on \_\_\_\_\_ as

Application No. \_\_\_\_\_

and was amended on \_\_\_\_\_;  
(if applicable)

I HAVE REVIEWED AND UNDERSTAND THE CONTENTS OF THE ABOVE-IDENTIFIED SPECIFICATION, INCLUDING THE CLAIMS, AS AMENDED BY ANY AMENDMENT REFERRED TO ABOVE;

I ACKNOWLEDGE THE DUTY TO DISCLOSE TO THE OFFICE ALL INFORMATION KNOWN TO ME TO BE MATERIAL TO PATENTABILITY AS DEFINED IN TITLE 37, CODE OF FEDERAL REGULATIONS, Sec. 1.56 (as amended effective March 16, 1992);

I do not know and do not believe the said invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to said application; that said invention was not in public use or on sale in the United States of America more than one year prior to said application; that said invention has not been patented or made the subject of an inventor's certificate issued before the date of said application in any country foreign to the United States of America on any application filed by me or my legal representatives or assigns more than twelve months prior to said application;

I hereby claim foreign priority benefits under Title 35, United States Code Sec. 119 and/or Sec. 365 of any foreign application(s) for patent or inventor's certificate as indicated below and have also identified below any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application(s) on which priority is claimed:

## COMBINED DECLARATION AND POWER OF ATTORNEY

Attorney's Docket No.

025219-260

COUNTRY/INTERNATIONAL	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED
France	99 08476	01, July, 1999	YES <u>X</u> NO <u>  </u>
			YES <u>  </u> NO <u>  </u>

I hereby appoint the following attorneys and agent(s) to prosecute said application and to transact all business in the Patent and Trademark Office connected therewith and to file, prosecute and to transact all business in connection with international applications directed to said invention:

William L. Mathis	17,337	R. Danny Huntington	27,903	Gerald F. Swiss	30,113
Robert S. Swecker	19,885	Eric H. Weisblatt	30,505	Michael J. Ure	33,089
Platon N. Mandros	22,124	James W. Peterson	26,057	Charles F. Wieland III	33,096
Benton S. Duffett, Jr.	22,030	Teresa Stanek Rea	30,427	Bruce T. Wieder	33,815
Norman H. Stepno	22,716	Robert E. Krebs	25,885	Todd R. Walters	34,040
Ronald L. Grudziecki	24,970	William C. Rowland	30,888	Ronni S. Jillions	31,979
Frederick G. Michaud, Jr.	26,003	T. Gene Dillahunt	25,423	Harold R. Brown III	36,341
Alan E. Kopecki	25,813	Patrick C. Keane	32,858	Allen R. Baum	36,086
Regis E. Slutter	26,999	Bruce J. Boggs, Jr.	32,344	Steven M. du Bois	35,023
Samuel C. Miller, III	27,360	William H. Benz	25,952	Brian P. O'Shaughnessy	32,747
Robert G. Mukai	28,531	Peter K. Skiff	31,917	Kenneth B. Leffler	36,075
George A. Hovanec, Jr.	28,223	Richard J. McGrath	29,195	Fred W. Hathaway	32,236
James A. LaBarre	28,632	Matthew L. Schneider	32,814		
E. Joseph Gess	28,510	Michael G. Savage	32,596		



21839

and: \_\_\_\_\_

Address all correspondence to:



21839

Robert E. Krebs  
BURNS, DOANE, SWECKER & MATHIS, L.L.P.  
P.O. Box 1404  
Alexandria, Virginia 22313-1404

Address all telephone calls to: Robert E. Krebs at (650) 622-2300.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF SOLE OR FIRST INVENTOR	SIGNATURE	DATE
Laurent Ouvry		
RESIDENCE	CITIZENSHIP	
33, avenue Jeanne d'Arc, 38100 Grenoble, France	France	
POST OFFICE ADDRESS		
same as above		
FULL NAME OF SECOND JOINT INVENTOR, IF ANY	SIGNATURE	DATE
Didier Varreau		
RESIDENCE	CITIZENSHIP	
177, chemin de Marseillere, 38450 St Georges De Commiers, France	France	
POST OFFICE ADDRESS		
same as above		

**COMBINED DECLARATION AND POWER OF ATTORNEY**

Attorney's Docket No.

025219-260

FULL NAME OF THIRD JOINT INVENTOR, IF ANY		SIGNATURE	DATE
Didier Lattard			
RESIDENCE		CITIZENSHIP	
Les Rithons, 38680 Rencurel, France		France	
POST OFFICE ADDRESS			
same as above			
FULL NAME OF FOURTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
Sebastien Leveque			
RESIDENCE		CITIZENSHIP	
16 rue Joya, 38000 Grenoble, France		France	
POST OFFICE ADDRESS			
same as above			
FULL NAME OF FIFTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			
FULL NAME OF SIXTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			
FULL NAME OF SEVENTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			
FULL NAME OF EIGHTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			
FULL NAME OF NINTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			
FULL NAME OF TENTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			